GIS000380

ACQUISDATA

INVESTMENT RESEARCH AWARDS 2016 WINNER BEST INDUSTRY RESEARCH

Global Industry
SnapShot

Internet of Things (IoT)

September 28, 2020

Contents

Contents

This Week's News

Industry News

Yahoo - Senet Closes $16M Funding Round to Drive Widespread Adoption of Low Power Wide Area Networks and Solutions for IoT Applications– 22/09/20

Senet, Inc., a provider of cloud-based software and services platforms that enable global connectivity and on-demand network build-outs for the Internet of Things (IoT), has secured a $16 million funding round led by Fisk Ventures.(https://finance.yahoo.com/news/senet-closes-16m-funding-round-110500492.html)

Nasdaq– Amazon Sidewalk to Target Smart Home Market– 22/09/20

Amazon has partnered with Semtech Corporation to use the vendor's LoRa technology on its forthcoming Sidewalk network. It will connect both outdoor and indoor, low-bandwidth smart home products, including smart lights, pet trackers, sensors for asset tracking, smart irrigation, and a multitude of additional low cost devices targeted for domestic use. (https://www.nasdaq.com/articles/amazon-sidewalk-wants-to-connect-all-devices-in-your-neighborhood-2020-09-22)

GlobeNewswire– Nokia and Optus to provide IoT software solutions to Australian Industries– 23/09/20

Nokia and Optus to provide IoT software solutions to Australian mining, utilities and transportation industries. Anticipated industry applications include cost effective waste management, supply chain optimization, logistics management and scene analytics for improved safety and security. (https://www.globenewswire.com/news-release/2020/09/24/2098402/0/en/Nokia-and-Optus-to-provide-IoT-software-solutions-to-Australian-mining-utilities-and-transportation-industries.html)

International Data Corporation – Worldwide Wearables Market Forecast to Maintain Double-Digit Growth in 2020 and Through 2024– 25/09/20

Global shipments of wearable devices are expected to total 396.0 million units in 2020 according to new data from the International Data Corporation (IDC) Worldwide Quarterly Wearable Device Tracker. This marks a 14.5% increase from the 345.9 million units shipped in 2019. (https://www.idc.com/getdoc.jsp?containerId=prUS46885820)

Company News

PR Newswire– Silicon Labs and Amazon Collaborate on Sidewalk, a New Shared Network for IoT Consumer Devices– 21/09/20

Silicon Labs (NASDAQ: SLAB) collaborated with Amazon to support Amazon Sidewalk, a shared network created by neighbors who share a small portion of Wi-Fi bandwidth to help their devices work better at home and beyond the front door. (http://www.prnewswire.com/news-releases/silicon-labs-and-amazon-collaborate-on-sidewalk-a-new-shared-network-for-iot-consumer-devices-301134290.html)

Bloomberg– Intel Introduces IoT-Enhanced Processors to Increase Performance, AI, Security – 23/09/20

At the Intel Industrial Summit 2020, Intel announced new enhanced internet of things (IoT) capabilities. The 11th Gen Intel Core processors, Intel Atom x6000E series, and Intel Pentium and Celeron N and J series bring new artificial intelligence (AI), security, functional safety and real-time capabilities to edge customers (https://www.bloomberg.com/press-releases/2020-09-23/intel-introduces-iot-enhanced-processors-to-increase-performance-ai-security)

Yahoo– Hitachi Begins Testing of 5G Powered Industrial IoT Solutions– 25/09/20

Hitachi begins testing Ericsson's 5G-powered industrial IoT solutions at its Silicon Valley research center. The network will leverage 5G and Hitachi's platform technology to accelerate the development of 5G-enabled IoT uses cases. (https://sg.news.yahoo.com/hitachi-begins-testing-5g-powered-024400587.html)

1 Industry Snapshot

1.1 Introduction

In a relatively short period of time, the internet has evolved to have an amazingly profound impact on almost every facet of our lives. We are now heading into a new era of ubiquity with billions of internet users. Much of the communication between human beings now takes place on a range of devices, many of which have Wi-Fi or mobile internet capabilities and sensors built into them, thereby creating a much wider and more complex Internet of Things (IoT).

IoT is a network of sensors, electronic, network connectivity and software working together to enable smart devices to gather and exchange data. As IoT grows, sensors play an increasingly important role in measuring the quality of objects and enumerating them into values, which are readable by other devices and users. More and more smart devices can now communicate with each other through embedded IoT sensors, actuators and tags.

While smart devices and related products are now used widely, smart grids, intelligent traffic management systems, smart electricity, utilities, gas and water meters are expected to be increasingly connected over the next few years. Such connectivity will open considerable opportunities for further growth of the IoT sensors market.

Billions of gadgets, trillions of gigabytes of data, and billions of dollars in investment and revenue will be the enablers. Added to the market opportunities will be podcasts, blogs, micro blogs and electronic books. The pattern of growth is broad-based across a range of markets and sectors, from health, manufacturing, retail, government services and transportation. Just as the internet has touched all industries, IoT will affect all sectors of the economy.

IoT could be the most dynamic segment of the information and technology sector in this coming decade. According to research firm IDC, the market (by revenue) was estimated at ~$745 billion in 2019 and could reach $1 trillion by 2022. Software and services are likely to account for majority of the IoT spending.

Basic infrastructure to support IoT, like mobile data services, Wi-Fi and Internet cafes, is already in place in many developing communities, with near-ubiquitous basic mobile connectivity. According to IoT Analytics, the total installed base of IoT devices reached ~9.5 billion as of the end of 2019, significantly higher than the forecast of ~8.3 billion. It is projected to exceed 22 billion by 2025. The consumer segment is likely to account for the largest pie of the installed base. Another forecast by the ITU suggests that IoT installed base will exceed 25 billion devices by 2020. This was echoed by Ericsson which also estimates ~24.9 billion IoT devices by 2025.

IoT industry is seeing significant acceleration in certain areas amid the COVID-19 pandemic. While there is decreased interest in consumer IoT devices, many other areas especially related to manufacturing, supply chain, healthcare etc. are booming. As businesses are forced to implement social distancing measures due to pandemic, there is growing demand for more automation which is driving demand for IoT solutions.

Based on the figures alone, the failure to invest in IoT or plan to invest in IoT could lead to huge missed opportunities for tech companies, governments and investors. Most technology big names, apart from offering IoT products and components, are investing heavily in the market. For instance, IBM (NYSE: IBM) has developed a platform, Watson, that uses natural language processing and machine learning to reveal insights from large amounts of unstructured data. Already used widely, devices could offer IoT connectivity to a range of devices as well as provide cloud services.

Watson has been embraced by universities, movie directors, chefs and designers and more, and soon Watson will offer roadside assistance, business messaging and education, with IBM recently signing deals with General Motors (NYSE: GM), Slack and Pearson (LON: PSON). Watson IoT solutions for automotive industry captures data from in- car sensors and external environment to improve mobility experience.

Qualcomm (NASDAQ: QCOM) and Intel (NASDAQ: INTC) are also designing chip-based platform for IoT connectivity on both portable and non-portable devices, while mobile makers like Samsung (KRX: 005930), Apple (NASDAQ: AAPL) and even BlackBerry (NASDAQ: BBRY) are getting into the mix and developing their IoT businesses.

IoT thus is set to open new opportunities for growth, innovation and knowledge creation. The potential and benefits of IoT are huge and at this stage hard to forecast but they may be far bigger than anyone realizes. Consumers are already demanding devices that connect and sync seamlessly and as consumer preferences evolve.

1.2 Market Scope

Much of the early discussion surrounding IoT has focused on the projections of the future market size; but IoT is beyond the hype and is now a reality. Industry experts and consumers will continue to peg IoT as the next Industrial Revolution and the Next Internet, thanks to the way businesses, governments and consumers interact with the physical world. IoT will also continue to diffuse around the world, as designs become more streamlined and efficient and as more industries adopt existing business processes for IoT use.

While the vast majority of IoT innovators are based in the US, some of the strongest interest in IoT and data analytics technologies - particularly in smart cities and driverless vehicles - is coming from the Asia-Pacific and Europe. The IoT sector, therefore, presents huge opportunities and scope in these emerging markets.

Singapore in particular has perhaps the most advanced smart city technology in the world, while India is starting to aggressively rollout its plans for smart cities. In addition, with the emergence of new players in developing markets, such as China, Taiwan, Japan, India, Australia, Russia and Brazil, and the implementation of improved and advancing technologies will lead to the intensification of competitiveness in the sector.

Smart city initiatives are being increasingly rolled out around the world to tackle increased urbanization, meet environmental targets and reduce energy consumption of cities. The city of San Diego is undertaking a massive street light IoT project. It is in the process of growing its wirelessly-connected street light portfolio to 14,000 nodes that will collect data and support IoT services such as traffic monitoring, parking utilization, and more. Many other cities including Miami, Paris, Madrid, Los Angeles are following similar approach. Miami has ~500,000 connected street lights, Paris has 280,000 connected street lights, Madrid has 225,000 connected street lights and LA has 165,000 connected street lights.

With the explosion of interest in building and operating IoT and analytics, the use of the technologies is set to generate more high-tech jobs, with millions in tax revenues and tens of billions in economic impact. Global revenues, according to the IDC, were ~$726 billion in 2019 and could surpass $1.1 trillion by 2023. Software and services accounted for majority of IoT spending, totaling $412 billion. The Asia-Pacific was the largest region accounting for 35.7% of the total 2019 IoT spending, followed by US (27.3%) and Europe (21.2%).

The United States and China were the largest market (by revenue) for IoT spending in 2019 at $198 billion and $169 billion respectively. The sector that attracted the largest share of IoT spending in 2019 was manufacturing. This was followed by Consumer IoT where spending was $108 billion in 2019. The leading consumer use cases were related to the smart home, personal wellness, and connected vehicle infotainment.

Combined with forecast growth in the technology sector, IoT technology is moving ever faster forward as the market continues to flourish. ITU data also suggests the IoT market could have 25 billion connected devices by 2020. Another estimate from IDC projects the total number of IoT devices to reach 41.6 billion by 2025 and the total data to be produced at 79.4 zetabytes. The massive amount of data anticipated to be generated as a result of IoT has potential to unlock trillions of dollars of value. Cisco estimates that IoT could add ~$19 trillion in economic value by 2024. IoT could touch every industry, with many sectors already seeing its effects on healthcare, automotive and manufacturing.

Impact of COVID-19

COVID-19 is leading to accelerated adoption of many IoT use cases specifically in manufacturing, supply chain, healthcare, smart cities and others. It is expected that going forward businesses will need to automate processes and remotely access assets as social distancing norms stay in place.

Demand for remote access tools which allow companies to remotely communicate with machines and perform virtual inspections, remote diagnostics as well as remote support are in high demand. Canada-based Librestream Technologies reported a ~2x jump in demand for its remote software in March 2020 versus February 2020.

Healthcare is one area which has seen massive growth in digitization. Digital diagnostics which use IoT devices are gaining traction. Remote monitoring of the elderly is also on the rise. Robots equipped with IoT sensors are being used across the world particularly in China to disinfect hospitals and perform delivery of medicines to infected patients. Also, smart bracelets with IoT sensors are being used by patients to monitor their vitals, including temperature, heart-rate, and blood-oxygen levels. Business Insider predicts that the Internet of Medical Things (IoMT) market is expected to grow to $158 billion by 2022.

IoT solutions are being used for getting real-time visibility of the supply chain. This is crucial as the current pandemic has disrupted logistics and supply chain leading to delays and losses. Firms are using solutions such as Vesseltracker.com to track the movement of their vessels and get an idea on the estimated arrival time.

IoT systems are being used by many governments to track infections, people movement, detect potential carriers, and remotely monitor health conditions. However, increasing use of these tools bring about other challenges related to data security and privacy.

1.3 Market Trends

Automated Vehicles Become Connected

Connected vehicles are the most obvious and familiar example of IoT technology. Cars are now seamlessly connected to mobile devices, receiving real-time traffic alerts and offering services and help to drivers, including emergency road assistance all at the touch of a button. This shows that the automotive ecosystem is becoming more than just the car and its maker.

In the automotive sector, vehicles embedded with IoT connectivity will be supplemented by a variety of add-on devices for specific purposes, such as fleet management. According to Gartner, one in five vehicles will have some wireless connectivity by 2020, taking the total connected cars to ~250 million. Gartner further projects that automotive industry will become the largest market opportunity for 5G IoT solutions. It will represent 53% of the overall 5G IoT endpoint opportunity in 2023. According to Subex, the Automotive IoT market is projected to reach $82.7 billion by 2022.

For now, self-driving cars can be seen only in prototype vehicles, but it is being discovered by automakers, like Tesla (NASDAQ: TSLA), Bosch, Nissan (TYO: 7201) as well as the likes of Google, Amazon, Microsoft and Uber. Tesla, working together with NVIDIA on the use of Drive PX2 in the new Autopilot and Self-Driving Capable hardware suite, is aiming to get automated vehicles on the road commercially by 2020. Other automotive companies like Toyota (TYO: 7203) and Google are also active in the emerging market.

Automotive conglomerates like Daimler (FRA: DAI), Ford (NYSE: F), Audi (FRA: NSU), Volkswagen (FRA: VOW), Volvo (STO: VOLV-A) and others, are making their own efforts towards self-driving vehicles. Ford has start testing its autonomous vehicle technology, with commercial production anticipated by 2021.

Mayo Clinic in the US has been using autonomous vehicles or driverless shuttle to deliver COVID-19 tests from testing facility to a processing lab. This service has been running since 30 March 2020 and currently four such shuttles are operational.

Most developed cities are now working on long-term smart city plans that contemplate automated cars. For instance, Singapore is taking the smart city concept onto a whole new level by opening its streets to self-driving cars and buses. The country is also adjusting its technological infrastructure for more sustainable, productive, and livable environments, including more aggressive contemplation and deployment of IoT-based services.

Even though self-driving vehicles will not suddenly become available overnight, it's clear that developments and pilot projects will mean the technology will become mainstream much faster than

anticipated, with many developed nations around the world wanting it to happen as soon as possible. Transport planning in many countries is about to get more complicated. Government policies will play a significant role in fueling the growth connected cars. Both in the US as well as EU, regulations around safety are becoming tighter.

As IoT technologies transform the automotive sector, the sector will witness a steady influx of new players and evolving relationships between automakers, software and hardware providers. A growing number of companies are beginning to proclaim that self-driving cars are only a few years from prime time.

IoT and Big Data Starts to Merge

Every hour of the day, more than one hundred million photos are uploaded to Facebook, Instagram and other social media networks, while every second, one hour's worth of video footages are uploaded onto YouTube. Google projects that to process over a petabyte of data every day is about a hundred times the data stored in the US Library of Congress.

Beyond big data analytics itself, there is also a need for real-time insight. In many ways, this is where IoT brings the biggest promise. Big data analytics produced by IoT often involves immediacy, responsiveness and even user predictive and personalized options. According to IDC, the IoT analytics market could reach ~$23 billion by 2020.

A study by Oracle (NYSE: ORCL) suggests that by 2020 IoT could generate a stunning 4.4 trillion gigabytes of data in the world. Another estimate from IDC suggests that IoT devices could generate 79.4 zetabytes of data by 2025. For now, that number is a bit hard to comprehend, but bearing in mind that by then tens of billions of sensors and devices will be online. With no data, all IoT sensors and devices will not have the same uses and capabilities that have allowed them to gain so much worldwide attention.

As IoT grows, more demand and emphasis will be placed on businesses' big data capabilities. As such, solutions such as cloud services like Platform-as-a-Service (PaaS) or Software-as-a-Service (SaaS) will soon become a necessity for organizations dealing with large amount of data and IoT.

The maturation process of the IoT and big data analytics world will, in the future, involve developments that are more exciting than those seen over the last few years. Current and traditional tech leaders, such as IBM, SAS Institute and SAP (FRA: SAP), are now racing to compete against challengers like General Electric, Bosch, Cisco, Dell (NASDAQ: DELL), Microsoft, Intel and Oracle, among others, which are coming strong on IoT and big data.

IoT and Blockchain

Blockchain technology has sparked a lot of enthusiasm about its possible use in IoT. According to IoT Analytics, spending (by revenue) for Industrial & IoT Blockchain is projected to touch $573 million by 2023. With IoT devices expected to increase rapidly, the need to extract more value out of the data is gathering momentum. This has given traction to the idea of IoT data marketplaces. Enabled by blockchain, these marketplaces will facilitate the exchange of IoT data between buyers and sellers. Western Digital estimates that the blockchain-enabled IoT data marketplaces revenue could reach $4.4 billion by 2030.

IBM is the current Industrial and IoT Blockchain market leader with an estimated 20% of global market share. Many other firms are ramping up their presence in this space.

The US Department of Homeland Security (DHS) is beta testing blockchain technology for securing IoT devices. WISeKey, a leading information security and identity management company has introduced its first All- Blockchain IoT platform between China and the US. It offers a secure and trusted way to connect US based enterprises with their Chinese counterparts via blockchain.

The supply chain industry can immensely benefit from the combination of IoT and Blockchain. Supply chain is the #1 application area for blockchain from an Industrial and IoT project standpoint. For instance, using IoT it is possible to track perishable commodities from suppliers to customers. IoT sensors can keep track of entire journey including temperature conditions during shipment. This data can be automatically loaded onto blockchain networks which safely and securely stores the information. This can then be used to identify any contamination that might occur during transit and expedite product recalls.

The Singapore branch of CIMB Bank completed a trade financing transaction for the import of dairy products into China using IoT cargo sensors and blockchain platform in October 2019. For the transaction, all data and documents were shared on a blockchain. And the cargo was tracked in real-time using IoT sensors.

The IoT Tech Funding Frenzy

As of the end of Q120, the total IoT funding was $4.7 billion, according to Venture Scanner. This is up 15% YOY. The funding for 2019 was $16.3 billion. The Chinese government has laid an objective for enabling around 1.7 billion public machine-to-machine (M2M) connections by 2020 and becoming a CNY1.5 trillion IoT market. Moreover, China is also aggressively working on setting international standards for IoT, which is expected to attract more investments.

Several tech giants, namely Dell, IBM, Texas Instruments (NASDAQ: TXN), Intel and many others, have announced that they are creating or expanding their IoT business. Apart from tech companies, in the areas of manufacturing automation and optimization, equipment monitoring, field service, and smart product development, incumbents such as General Electric, Siemens and new entrants like PTC's (NASDAQ: PTC) ThingWorx, are actively pursuing IoT.

A New Industrial Sector Landscape Emerges – IoT

With the high level of interest and hype around IoT, the market is now seeing greater interaction with various market sectors. In many cases, companies that were previously identified as part of one sector, are moving into another. Indeed, energy, healthcare, automotive and other sectors are beginning to grapple with the Industrial Internet of Things (IIoT).

IIoT happens when devices such as sensors, robots, mixing tanks, production lines, insulin pumps, among others, become increasingly connected — primarily in respect to machine-to-machine (M2M) communication. Accenture estimates the Industrial Internet of Things (IIoT) could add $14.2 trillion to the global economy by 2030. According to consulting firm Bain and Company, the size (in terms of revenue) of the IIoT market could reach $200 billion by 2020.

The driver behind IIoT is that smart machines are more effective than humans in accurately and consistently capturing and communicating data. The data obtained allows companies and manufacturers to pick up inefficiencies and problems real-time, thus saving costs and time and supporting business intelligence efforts.

Just like IoT, IIoT is growing and expanding rapidly, thanks to smart devices and connected sensors adoptions. As a result, countless manufacturers and industrial product companies are making great efforts to connect their products and appliances to the IoT. Also, IIoT is now being used in conjunction with AI to further improve the manufacturing productivity. AI using the data from IIoT sensors can predict, identify and share any anticipated in-line or production defect in advance so that the manufacturer is prepared to resolve it in time without hampering the production. For example, US-based chemical manufacturing company Texmark Chemicals has deployed senor-enabled pumps across its plants. These sensors gather operational data from such as temperature, pressure, vibrations, flow, and power. This data is analyzed to predict equipment failures before they happen.

According to IDC, manufacturing, transportation and utilities industries will account for the largest share of spend on IIoT solutions in the coming years, with specific focus on production asset management, freight monitoring and fleet management. IIoT solutions could generate more than $300 billion in revenue in the next two years, more than double that of consumer IoT solutions. The top-ranking use cases for IIoT include quality control, remote monitoring of equipment and tracking of assets or equipment on production sites.

IIoT, however, is not exempted from security, privacy and safety issues. To mitigate the risks that arise from technological development, companies and enterprises need to consider integrating advanced cyber threat protection solutions into their network. They should also leverage new collaboration channels between information technology and operations technology to their advantage in response to the obstacles.

The IoT will drastically change the future, not just for the industrial sector, but also for the services industry and all the personnel involved. For now, companies that move to undertake the necessary advancement will be able to position themselves as future leaders and stay ahead of the race in their

markets. Those that fail to work on the advancements now, however, will risk being left behind and face struggles to catch up in the future.

5G Could Kick Off an IoT Boom

Today's 4G wireless technology can handle certain IoT applications, but it suffers from latency and a lack of bandwidth. The connected (IoT) devices require large amounts of data to be transferred in real time. The next generation of wireless technology, known as 5G, is ideally suited for IoT devices as it has the bandwidth to support large amounts of data. According to Bain & Company estimates, the B2B IoT market could surpass $300 billion by 2020.

5G is expected to provide speeds faster than any previous generation technology. The speeds could be in the range of 700-3025 Mbps. One major advantage of using 5G would be the speed at which the data would get transferred. This is extremely important for large organizations which rely on big volumes of data to be shared or transferred speedily for effective functioning. Early 5G deployment is expected in 2018, but widespread implementation may take more than a couple of years. Corporates like Nokia, Qualcomm, Ericsson, Broadcom, and Verizon are all underway with their plans for technology and service deployment. 5G is ideally suited for Autonomous vehicles, robotic surgery, infrastructure monitoring, and energy management all of which require instant, continuous and real-time communication.

Outdoor surveillance cameras will be the largest market for 5G Internet of Things (IoT) solutions globally in the till 2023, according to Gartner. After this the automotive industry is expected to take over the number one mantle and will become the largest market opportunity for 5G IoT solutions. It will represent 53% of the overall 5G IoT endpoint opportunity in 2023.

The low latency of 5G networks can be used to collect and share real-time information about road users and the roadside infrastructure. For example, data about the location and speed of vehicles, number of pedestrians on the road, weather and road surface conditions, traffic jams and other obstacles on the road could be easily gathered and transmitted via 5G network.

While the use of 5G IoT systems is currently more prevalent in manufacturing sector, other areas such as financial services, retail and automotive are likely beneficiaries going forward. Banks which complete millions of transactions everyday can use 5G IoT system for faster execution and recording of transactions. Retail businesses can use 5G-enabled IoT devices for autonomous check-out. Similarly, autonomous vehicles equipped with 5G IoT devices can enable seamless communication and data transmission needed for safe navigation though the roads.

1.4 Applications

In IoT, products can refer to a device or a service such as Dropbox, OneDrive or Google Drive powered by software and other technology. IoT is transforming every facet of life. From the home, to the office, city streets and beyond, IoT products and services are giving everyone a greater control over door locks and home appliances, better connection between individuals, offering insights into resource consumption habits and streamline business processes.

Cloud-based data storage services and management toolset, smart automation devices, medical alert watches, smart running shoes, smart locks and one-button product purchases are among the best received IoT products and services to date. IoT products are services will continue to pick up steam as more IT vendors and service providers release new products and solutions, with almost every sector of the economy now being touched by IoT.

Consumer Applications

Consumers are seeing the emergence of an era in which consumer products and electronic or connected devices communicate with each other without human interaction. Smart homes filled with connected devices are filled with possibilities to make lives easier, more convenient, and comfortable. Devices from the likes of Fitbit, Garmin and their peer companies allow consumers to keep track on their health and workout progress in previously impossible ways.

Smartwatches, like those from Apple and Samsung, also bring the power of smartphone directly to a wearers' wrist. According to IDC, global shipments of wearable devices reached 336.5 million units during 2019, up 89% from the previous year. Earworn devices (hearables) were among the fastest growing categories, capturing 55.3% of the overall wearables market. Wristwear were the second largest category accounting for ~43.8% of overall shipments in 2019.

The use of consumer IoT systems especially smart speakers have surged due to the COVID-19 led shelter-at-home restrictions which has resulted in increased consumption of news, music and entertainment via these devices. Besides wearables and other electronic IoT devices which garner majority of media attention, many companies are working on other smart home solutions as well.

Internet of Things Integrated Buildings

Most buildings have some level of built in intelligence; for instance, HVAC, lighting, or fire safety detection and response. But technology is changing the forefront of construction. While the location still matters, information-based applications are now potentially adding new ways for the sector to create value for property buyers and investors and to compete with competitors.

IoT functionally in smart buildings manage lighting, temperature, and air quality levels and can enable or disable controlled zones that have revolutionized building management systems. Italy is one of the first few countries that introduced and adopted smart electrical metering. Consumers can keep track on the electricity consumption of each device they have at home to reduce costs through in-home energy display, using real-time feedback.

The IoT sensors in buildings is expected to grow rapidly. According to smart building research firm, Memoori, the global market for building IoT could reach $84 billion by 2022. According to IoT analyst firm Berg Insight, the installed base of IoT sensors in buildings could reach 483 million units by 2022 at a CAGR of ~33%.

Some of the major companies that have launched IoT building solutions include Siemens (FRA: SIE), AT&T, IBM Corp. IBM's Watson IoT solution for buildings is among one of the more prominent solutions. Watson IoT helps buildings become more efficient by using data from IoT sensors to provide real-time insights on buildings various operations. This can be used for optimizing safety, energy and other maintenance work.

Connected Manufacturing

The manufacturing sector is also starting to explore and implement IoT concepts and technology. Factories and   plants that are linked to the internet are typically more proficient, productive and smarter than their non-connected counterparts. Connected manufacturing allows factory personnel to remotely monitor production data for all plant equipment from one single point of access. Any issues leading to lower performance can be easily identified and addressed to improve productivity.

According to PricewaterhouseCoopers, IoT could help companies reduce overall costs by 3.6% annually.

ABI Research estimates that smart or connected manufacturing market will grow to ~$1 trillion by 2030, with 4.3 billion installed devices. The use of IoT devices has the potential to boost gross margin by 5% to 13% over five years for factories and warehouses.

Smart manufacturing, however, needs a healthy amount of technology rooted into the production line and machines   to make sure that all devices work together, and the enterprise is able to control and keep track of material flows visible in real time and personnel will orchestrate the whole manufacturing process.

Several regional initiatives are underway which are accelerating Industrial IoT (connect manufacturing) adoption. For instance, in Germany, there is "Industrie 4.0" while in the US, there is the "Manufacturing USA" initiative focuses on promoting IoT in manufacturing industry. South Korea plans to create 30,000 smart factories and ten smart industrial zones by 2022 to upgrade the South Korean manufacturing industry's competitiveness. The plan includes funding of up to KRW2 trillion to facilitate the setting of advanced manufacturing infrastructure.

Several leading global manufacturers, like Bosch (BOM: 500530), Cisco (NASDAQ: CSCO), Fiat Chrysler (NYSE: FCAU), General Electric (NYSE: GE), General Mills (NYSE: GIS), Harley-Davidson (NYSE: HOG) and Siemens— are the early adopters of smart manufacturing – or also known as Industry 4.0 – in their plants. Bosch estimates that connected solutions can boost productivity at individual plants by up to 25% and reduce inventories by as much as 30%. Schneider Electric has opened multiple smart factories around the world in countries including Mexico, China, France, India, the Philippines, Indonesia and the US.

Despite of the popularity, according to Rockwell Automation (NYSE: ROK) one of the companies that connects businesses and cyberspace together in order to improve manufacturing functions there are now only 10% of industrial operations are using IoT in their production line. But this may change soon, however. According to a report by Zebra Technologies, 64% of manufacturers believe that by 2022, their factories will be fully connected with the latest technologies powering IoT. Some of the most common things to be used to build smart factories include radio frequency identification (RFID) tools, wearables and small devices that can track equipment performance.

Many companies are benefitting from using IoT solutions and technology. Harley Davidson reduced its build-to-order cycle by a factor of 36 and grew overall profitability by 3% to 4% by shifting production to a fully IoT-enabled plant.

The possibilities of IoT are almost too far-reaching to imagine for the manufacturing and industrial sector. Its potential is clear and the impact of IoT in smart manufacturing is very big indeed. It is developing so fast that, for most manufacturers, by the time they get a chance to review or research on a new technology, technology has been replaced with a newer version.

Transportation and Logistics

In growing numbers, people are using public transportation, with both government and private organizations finding ways to improve and expand the transportation and logistics services. Regardless, transportation in ground, rail, air or sea, IoT solutions are being developed, improved and utilized, to address traffic congestion, safety, pollution, and efficient transport of goods.

Players such as Greyhound, Delta Airlines (NYSE: DAL), JetBlue Airways (NYSE: JBLU) and Amtrack, for example, have already started to understand and realize the value and potential of IoT towards their businesses. One of the uses of IoT is where sensors within a plane, help engineers to more easily secure the fleet and ensure that the aircrafts fulfill the Federal Aviation Administration (FAA) guidelines. The other important use is in tracking fuel usage for the fleet. Fuel typically accounts for the largest share of an airline's operating costs (20 to 40%). Improving fuel efficiency could significantly boost the bottom line.

In-flight connectivity is another area where potential of IoT is huge. Companies, like Gogo (NASDAQ: GOGO), Global Eagle Entertainment (NASDAQ: ENT), Thales via its LiveTV (EPA: HO), and Panasonic (TYO: 6752), are some of the leading players in the in-flight connectivity market. According to Juniper Research, in-flight entertainment and connectivity revenues are expected to touch $8.4 billion by 2023.

Other than aviation, train, bus and other transportation businesses are also jumping onto the bandwagon by making the internet, for instance, accessible in their vehicles to enhance commuters' experiences. IoT is changing the way we travel, whether it is across the country on a plane or from home to work on a bus.

The Port of Rotterdam has developed its own Internet of Things (IoT) platform. The system uses network of sensors to provide accurate and up-to-date water and weather data for the planning and management of shipping. The data transmitted by the sensors is analyzed by IBM's cloud-based IoT platform. The port authorities can use this information to make decisions that can reduce wait times, manage traffic more efficiently, decide best time for ship docking, load and unload among other advantages.

Another potential use case of IoT is in warehouse management. The online sales are projected to grow exponentially. eMarketer estimates ecommerce sales to touch $4 trillion in 2020 and grow to ~$6.5 trillion by 2023. The rising ecommerce penetration has led to increase in demand for smart warehouses that can handle large volumes efficiently. IoT technologies offer the promise of smart warehouses and also offer higher productivity by facilitating real-time information flow across the supply chain.

Government Monitoring and Controlling

Like businesses, both federal and the local governments are striving to offer quality services in the increasingly complex environment. At the Federal level, the agencies are more concerned on scaling measure capabilities. For instance, in the UK, Transport of London (TFL) has begun experimenting with IoT devices to improve public services.

In the US, the Department of Defense is using Radio-Frequency Identification (RFID) chips to monitor its supply chain more efficiently, while the US Geological Department employs IoT sensors to remotely monitor the bacterial levels of rivers and lakes around the country. RFID chips are usually embedded electronic devices that are used to transfer data to automatically identify and track tags that are attached to objects holding electronically stored information.

1.5 Regulatory Environment

IoT is changing the way people live, work and transact business, with this rapid explosion of technology, products, and services posing greater challenges around security, privacy, consumer rights, safety and industry development. As the cyber and physical worlds become increasingly intertwined, the need for regulatory intervention to tackle some of the challenges IoT presents is intensifying. IoT security is the primary concern for regulators as the number of connected devices continue to grow rapidly.

IoT devices are being used maliciously for cryptomining, ransomware and mobile malware attacks. According to Symantec, IoT-based attacks are likely to grow further particularly against poorly secured home-based IoT devices as well as against those that control critical infrastructure such as power distribution and communications networks.

The surge in medical IoT devices amid the COVID-19 pandemic makes the hospitals vulnerable to cyberattacks. Forrester Research noted that two US hospitals have already been attacked exploiting vulnerability in a medical IoT device (specifically, a remote patient-monitoring sensor) which led to breach of patient databases.

The Internet of Things Cybersecurity Improvement Act of 2019 introduced in the US is yet to pass and become a legislation. The bill defines set standards for IoT devices that are sold to the federal government as well as consumers. The bill requires IoT vendors to ensure the devices are secure from known vulnerabilities and can be patched if any other vulnerability shows up.

The state of California passed a bill to regulate IoT devices becoming the first US state to do so, even before the federal government. The legislation introduces security requirements for connected devices sold in the US. It forces manufacturers of the devices to equip them with appropriate security features. The bill will come effect into 2020. Going forward, this bill could spur similar IoT regulations in other states and even in other countries.

The UK government is also moving ahead with legislation that would ensure IoT devices are protected from cyberattacks. The legislation would make it mandatory for manufacturers or retailers selling IoT devices to ensure that basic security features are built-in the devices.

1.6 Challenges

While IoT holds huge potential, many developers are holding off on developing and launching IoT technologies. This is because with so much rapid IoT progress and accelerated integrations, there are a magnitude of barriers and challenges at play.

Data Security

Even though there are already many security tools that are suited for IoT devices, data security remains the main concern among developers. This is because IoT devices can potentially bring in large amounts of data and security breaches can be very dangerous. A network in which numerous devices, networks, and connections are connected and send out valuable data has the potential to exacerbate the cybersecurity challenges many organizations are already laboring under.

With devices connected to the internet, hackers can easily gain access if adequate security measures are not implemented. Even then, hackers are becoming smarter, more sophisticated, greater resourced and more determined. There is thus a need for intense security and privacy protection in the IoT.

Organizations like the Internet Engineering Task Force (IETF) — an international standardization organization — for instance, is working on a number of security measures related to IoT. In the US, the Federal Trade Commission is also tackling the matters with the tech sector on how to guarantee that privacy and security safeguards are embedded into new connected devices without stifling innovation.

Globally, regulatory policy is being drafted in the EU and also in the US, with California leading the charge with the introduction of IoT legislation and in the process becoming the first state in the US to do so. The legislation requires connected device manufacturers to install security features during the initial stage of development. In the US, the proposed Internet of Things Cybersecurity Improvement Act of 2017 compels sellers to make sure their devices are reliant on industry standard protocols.

User Privacy

It is no secret that mobile devices and wearable devices come with default settings that track movement. For   instance, an Apple (NASDAQ: AAPL) Watch, Garmin (NASDAQ: GRMN) or Fitbit (NYSE: FIT) wearable tracks and communicates your every movement throughout a city.

Data collected from devices, together with wearable technologies, will automatically share and transmit any data collected to vendors, companies and developers. For users, this information, especially personal information, is usually kept personal and privacy. Just like security, privacy is also a major challenge in the IoT development   process.

As it becomes more difficult for users to get off the grid, and as IoT unlocks new technologies, it will be up to companies and vendors to maintain a level of trust between consumers and developers. There are already several responsible and trusted vendors – like Symantec (NASDAQ: SYMC), NEC (TYO: 6701), Gemalto (AMS: GTO) and Infineon (FRA: IFX) – that help mitigate the risk of privacy breach together with proven technologies like end-to-end encryption and token-based authentication that are suited for IoT applications.

IoT development is also coinciding with the intensification of data privacy legislation around the world, as nations seek to keep up with connected technologies at large and balance industry innovation and consumer protection. For instance, in Canada, the Personal Information Protection and Electronic Documents Act (PIPEDA) calls for companies to develop a confidentiality management program to limit the collection, use and retention of data, as well as give users the right to access to the information that the company has about them, and provide a way for users to file complaints with the company.

Powering IoT Devices

While the challenges above are all significant, another is finding dependable electricity sources to power billions IoT devices. As everything requires energy to exist and with the battery life on smartphones often struggling to keep up with user behavior, developers are looking for more power to support product development.

Apart from powering mobile devices, which is only one barrier, powering data centers and physical machines is a whole other challenge to the sector. For this reason, companies are finding ways to create a 100% renewable energy supply to fuel their data centers. Sustainability leaders include Apple, Amazon Web Services (NASDAQ: AMZN), Facebook (NASDAQ: FB), Google (NASDAQ: GOOGL), and Microsoft (NASDAQ: MSFT).

There is still a long way to go before there are solutions that can truly provide adequate power for all IoT devices. As the world marches towards 50 billion connected devices, the need for more flexible renewable power supply is becoming a common problem, especially for IoT tech conglomerates.

Cost of Production

The cost of production for most IoT-based technologies and devices remains high, and instead of costs going down, they are rising. The high costs are due to the cost of time, research, resources, and dedicated labor that is invested into IoT technologies. Challenges relating to security, data privacy, and ease-of-integration are also increasing the cost of production as well.

Standardization and Protocol

Even though a great deal of development has been made towards developing standards and protocols for IoT, robust and commonly used standards are needed in terms of security, privacy and most importantly, architecture. IoT design engineers are faced with a variety of connection technologies that they must incorporate within any device if it is to talk with other devices it may run into.

Currently, Wi-Fi, Bluetooth, Bluetooth low energy, ANT, ZigBee and RF4CE are among the popular IoT protocols. There, however, are hundreds of smaller standards in the market. All protocols and standardizations chosen could ultimately limit its IoT adoption; thus, the lack of standards compatibility could continue to be a big challenge.

Despite the abovementioned barriers and other hurdles, IoT product and services development remains ongoing. There will be many opportunities and pathways for development in the technology sector. Other emerging industries that deal with technology are now certain to produce ways to power devices and maintain security and privacy of the sector.

2. Leading Companies

2.1 Alphabet Inc (Nasdaq: GOOGL)

Alphabet Inc, through its subsidiaries, provides online advertising services worldwide. The company operates through Google and Other Bets segments. The IoT segment is a part of the Other Bets segment. Google's cloud platform includes several IoT offerings and services that help customers connect devices and processing the IoT data.

Google's bid to acquire Fitbit Inc. for ~$2.1 billion, if successful will further expand its IoT portfolio by entering the wearable space which is one of the fastest growing markets. The merger is under regulatory approval.

Alphabet reported weak revenue growth for the second quarter of 2020. The revenue was $38.2 billion, down 2% YOY due to decline in advertising business. However, the company noted strong growth in Google cloud and other revenues.

On 3 December 2019, Alphabet Inc. announced that its co-founders Larry Page and Sergey Brin are moving away from their roles of CEO and President respectively. They will continue as founders, shareholders and board members. Sundar Pichai CEO of Google became CEO for both Alphabet and Google.

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	June 30, 2019	June 30, 2020	December 31, 2018	December 31, 2019
Revenue	US$38,944	US$39,297	US$136,819	US$161,857
Operating Income	US$9,180	US$6,383	US$27,524	US$34,231
Net Income	US$9,947	US$6,959	US$30,736	US$34,343
Total Assets	US$257,101	US$278,492	US$232,792	US$275,909
Total Equity	US$192,192	US$207,322	US$177,628	US$201,442

Figure 1: LTM Performance vs. SPX 500 Index

Source: Nasdaq[1]

2.2 Apple Inc (Nasdaq: AAPL)

Apple Inc designs, manufactures and markets mobile communication and media devices, personal computers, and portable digital music players. It also deals with a variety of related software, services,

---

[1] http://www.nasdaq.com/symbol/ibm/stock-chart?andintraday=offandtimeframe=1yandsplits=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500

peripherals, networking solutions, and third-party digital content and applications. The corporation is slowly releasing new software and hardware that will incrementally take the company into the IoT market.

For example, Apple is using its HomeKit system, Apple Watch, and new automotive pursuits to advance the company's position into a future where nearly everything around us is connected to the internet. Apple Watch which helps users keep track of their vital parameters has positioned the company as a premier player in the IoT market in healthcare.

Apple Watch was the leading smartwatch with a market share of ~36.8% as of Q120, according to technology market analyst firm Canalys. Apple is focused on further strengthening its foothold in the wearables market with launch of new features. The wearables business grew over 23% YOY in Q220.

The company posted strong revenue growth for Q320 (three months ended 27 June 2020). Revenue stood at $59.7 billion, up 11% YOY. The growth was driven by Products and services segment across geographies. The company did not offer any guidance for Q420 amid uncertainty due to COVID-19 pandemic. It did however expect strong performance from iPhone.

Latest Key Financial Data

(In millions of US$)	Quarter Ending		Fiscal Year Ending	
	June 29, 2019	June 27, 2020	September 29, 2018	September 28, 2019
Revenue	US$53,809	US$59,685	US$265,595	US$260,174
Operating Income	US$11,544	US$13,091	US$70,898	US$63,930
Net Income	US$10,044	US$11,253	US$59,531	US$55,256
Total Assets	US$322,239	US$317,344	US$365,725	US$338,516
Total Equity	US$96,456	US$72,282	US$107,147	US$90,488

Figure 2: LTM Performance vs. SPX 500
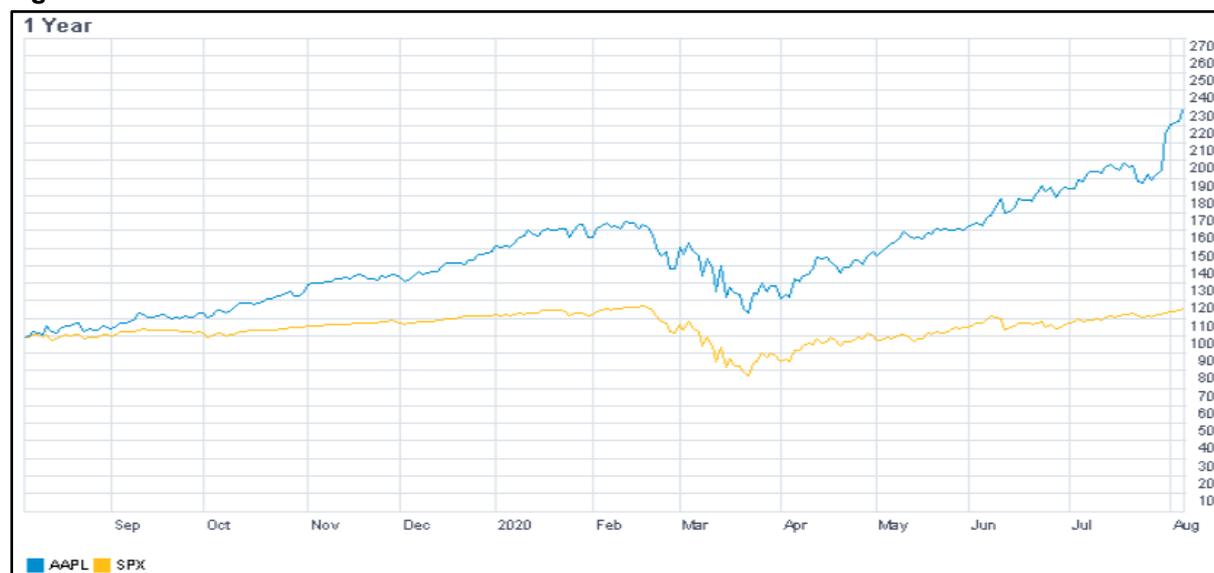
Source: Nasdaq[2]

2.3 Ayla Networks

Ayla Networks is an Internet of Things (IoT) platform provider focused on connecting devices to its cloud platform. The company empowers leading manufacturers by simplifying the inherent complexity of the IoT. Ayla also offers Agile Mobile Application Platform (AMAP), an application which jump-starts the development of iOS and Android applications for controlling various types of IoT devices.

Ayla has been recognized as one of the companies in the 2019 Deloitte Technology Fast 500 list of the fastest-growing technology companies in North America. Ayla is an expert in building enterprise-

---

[2] http://www.nasdaq.com/symbol/aapl/stock-chart?intraday=offandtimeframe=1yandsplits=offandearnings=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500anddrilldown=off

class cloud based software for the Internet of Things, enabling some of the largest companies in the world to turn everyday home controls and appliances, commercial, and industrial devices into intelligent systems.

Ayla's IoT Platform comprises four primary components -1) Edge Connectivity; 2) Device Management; 3) Data and Applications; and 4) Security and Compliance. Ayla's Platform provides a complete solution to securely connect any device to any application while offering all of the tools necessary to provision and manage connected products at scale.

2.4 Cisco Systems Incorporated (NASDAQ: CSCO)

Cisco is a multinational corporation that designs, manufactures and sells networking equipment globally. It is the largest networking company in the world. The company operates through three geographic segments — Americas; Europe, the Middle East and Africa (EMEA), and the Asia-Pacific, Japan and China (APJC). It groups its products and technologies into various categories, such as switching, Next-Generation Network (NGN) Routing, data center, wireless service provider, video security and many more. In addition to its product offerings, the company also provides a range of service offerings, including technical support services and advanced services.

Some of the key IoT offerings include the following:

Jasper IoT Platform: is exclusively focused on cellular-connected devices. According to Cisco, Jasper currently supports over 17,000 enterprises with 85 million devices, adding about 2 million new devices each month. Some examples include Cisco Jasper being used by telecom major MTN to enable internet of things worldwide connectivity for business customers throughout South Africa.

Kinetic IoT Platform: is not limited to cellular services and encompasses all kinds of wired and wireless devices. Cisco will partner with Teradata for IoT enabled smart city solutions. Cisco announced collaborating its Kinetic IoT platform with the Teradata Analytics Platform to help cities become smarter and more connected.

NB-IoT Platform: is focused on low power use cases and business models. NB-IoT dramatically reduces the power and cost of connectivity. The platform was commercially launched worldwide in February 2018.

The company reported weak Q420 (three months ended 25 July 2020) results. Total revenue was $12.2 billion, down 9%, with product revenue down 13% and service revenue flat YOY. Revenue across all geographies was down: Americas down 12%, EMEA down 6%, and APJC down 7%. For Q121, the company is guiding for revenue decline in range of 9%-11% YOY.

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	July 25, 2020	July 27, 2019	July 25, 2020	July 27, 2019
Revenue	US$12,154	US$13,428	US$49,301	US$51,904
Operating Income	US$3,247	US$3,690	US$13,620	US$14,219
Net Income	US$2,636	US$2,206	US$11,214	US$11,621
Total Assets	US$94,853	US$97,793	US$94,853	US$97,793
Total Equity	US$37,920	US$33,571	US$37,920	US$33,571

Figure 3: LTM Performance vs. SPX 500 Index

Source: Nasdaq[3]

2.5 Comcast Corp (NASDAQ: CMCSA)

Comcast Corporation is a media and technology company whose primary businesses includes Comcast Cable and NBC Universal. In recent years, the company has been a victim of cable subscriber losses, but the company is working on a new method to make up for that problem — for instance taking opportunities with the IoT.

Comcast is making a play for enterprise IoT deployments in a venture called machineQ, which will use Semtech's technology focused on sensors and connectivity.

The company's flagship IoT solution named machineQ is an IoT network service and platform that uses Low Power Wide Area Network (LPWAN) technology. The LoRaWAN expertise ensures that sensors on our network collect and transmit data in the most reliable, secure, and power-efficient manner possible.

Its IoT platform makes it easy for enterprises to access real-time data and insights to make informed decisions. Some use cases for enterprises include:
Temperature Monitoring: Monitor temperature and humidity levels and receive live alerts, to respond quickly when conditions change.
Asset Tracking: Manage and track equipment, inventory, and other high-value assets in real time.
Facilities Management: Improve operational efficiency, reduce costs, and enhance tenant and customer experiences;
Predictive Maintenance: Predict and address issues proactively to avoid costly disruption.

The company delivered weak results for the second quarter of 2020 (three months ended 30 June 2020), impacted by COVID-19. The company reported revenue of $23.7 billion, down 11.7% YOY.

Latest Key Financial Data

(In millions of US$)	Quarter Ending		Fiscal Year Ending	
	June 30, 2019	June 30, 2020	December 31, 2017	December 31, 2019
Revenue	US$26,858	US$23,715	US$94,507	US$108,942
Operating Income	US$5,356	US$4,647	US$19,009	US$21,125
Net Income	US$3,203	US$3,009	US$11,862	US$13,323
Total Assets	US$256,555	US$265,978	US$251,684	US$263,414
Total Equity	US$77,830	US$84,791	US$72,502	US$83,874

Figure 4: LTM Performance vs. SPX 500

---

[3] http://www.nasdaq.com/symbol/googl/stock-chart?andintraday=offandtimeframe=1yandsplits=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500

1 Year

CMCSA ▪ SPX ▪

2.6 Cypress Semiconductor Corp (acquired by Infineon Technologies)

Cypress Semiconductor Corporation, an Infineon Technologies Company, designs, develops, manufactures, markets, and sells embedded system solutions worldwide. The company operates via two segments namely Microcontroller and Connectivity and Memory Products Division. Cypress IoT solutions are used in various medical, wearable and other IoT devices.

The company provides microprocessors which are used in IoT devices. The company has also entered the field of   IoT software with its WICED technology, an IoT Platform that combines wireless, MCUs, memory and PMICs into a platform to accelerate the time-to-market for connected IoT products. The WICED platform is used in various applications including home automation, fitness, automotive, industrial and medical.

Some of the other products that address diverse range of IoT applications include: 1) PSoC 4 L-Series, chip solution for smart home appliances and industrial internet applications; 2) FM4 products for factory automation and smart home appliance applications; 3) FM0+ products for portable IoT applications and 4) NOR Flash and NAND Flash: memories ideal for IoT data storage applications.

Cypress Semiconductor is pursuing growth opportunities in IoT with its PSoC 6 chip offering. These chips have advantages in power consumption, security, and programmability over competing products. Cypress' PSoC 6 chips used in many wearable devices including Fitbit Charge 3 fitness tracker and the Oura Ring sleep tracker. Cypress expects the IoT segment to remain its fastest growing until 2023, with a forecast CAGR of between 12% and 14%. The company expects that by the end of 2023, its IoT business will be its largest revenue generator.

2.7 Fitbit Inc (NYSE: FIT) (to be acquired by Google Inc.)

Fitbit Inc designs and sells connected health and fitness tracking devices. The company has variety of products such as:

1)Fitbit Zip, an entry level wireless activity tracker that allows users to track daily activity statistics, such as steps, distance, calories burned, and active minutes;

2)Fitbit One, a clippable wireless tracker, which tracks floors climbed and sleep, as well as daily steps, distance, calories burned, and active minutes;

3)Fitbit Flex 2, a water-resistant fitness wristband that tracks pool swims comprising laps, duration, and calories burned in the Fitbit App;

4)Fitbit Alta, a customizable wristband that offers call, text, and calendar notifications when paired with the user's phone and SmartTrack automatic exercise recognition;

5)Fitbit Charge, 2 a wireless heart rate and activity wristband. It was the #1 selling connected health & fitness tracker in the US in 2017;

6)Fitbit Blaze, a smart fitness watch that provides multi-sport functionality, tracks outdoor cycling activity, and run cues;

7)Fitbit Surge, a fitness watch that features a GPS watch, heart rate tracker, activity tracker, and smartwatch;

8)Aria, a Wi-Fi connected scale that tracks weight, body fat percentage, and BMI. The company expanded the product line with the launch of Fitbit Aria Air in August 2019. It is a low-cost scale which syncs to the phone via Bluetooth only.

9)Fitness Charge 3, advanced health and fitness tracker launched in Q318. Already among top selling devices in the US.

10)Fitbit Versa 2 launched in August 2019 is a premium voice-enabled lifestyle smartwatch. It is packed with more advanced health, fitness and convenience features.

The company reported weak revenue growth for Q220 (three months ended 4 July 2020). The company revenue was $261.3 million, down ~17% YOY. The business was negatively impacted by the outbreak of COVID-19. International revenue declined by 27%, EMEA by 17%, APAC 47%, Americas (excluding US) dropped by 45% YOY.

On 1 November 2019, Google announced plans to acquire Fitbit for $7.35 per share in cash, valuing the company at ~$2.1 billion. Regulatory review of the transaction is ongoing. Fitbit noted that there is likelihood that the merger may not receive necessary regulatory approvals by the end of 2020.

Latest Key Financial Data

(In Millions of US$)	Three Month Ending		Fiscal Year Ending	
	June 29, 2019	July 4, 2020	December 31, 2018	December 31, 2019
Revenue	US$313.6	US$261.2	US$1,511	US$1,434
Operating Income	-US$70	-US$91	-US$189	-US$320
Net Income	-US$68	-US$104	-US$185.8	-US$320.7
Total Assets	US$1,278	US$1,042	US$1,515	US$1,368
Total Equity	US$625	US$430	US$735	US$487

Figure 5: LTM Performance vs. SPX 500

2.8 IoTium Inc

IoTium is a network infrastructure company for the Industrial Internet of Things (IIoT). It provides a IoT middleware platform for multiple vertical applications and services. It offers Network as a Service (NaaS) solution that enables clients to access to new analytics, machine learning, and predictive analytics applications via cloud. It offers services to oil and gas, manufacturing, transportation, and smart city industries, as well as building and industrial automation.

The company has been included in the "GSAM 100" by the GSMA Organization. The list includes companies that are leaders in categories that are poised to drive digital transformation and industry growth.

The company offers the following key IoT solutions:

OT-Edge: offers edge-cloud infrastructure for IIoT. OT-Edge enables critical data to reside on-premise when data must be kept locally to address compliance, security, latency or other practical concerns.

OT-Access: is a remote access management infrastructure offered as-a-service that puts enterprises in control of mission-critical assets.

OT-Net: allows organizations to securely and seamlessly connect all mission-critical industrial control and automation systems and assets.

2.9 International Business Machines Corporation (IBM) (NYSE: IBM)

International Business Machines Corporation, commonly known as IBM, is an American technology company that operates through five main segments - the Cognitive Solutions, Global Business Services (GBS), technology services & cloud platforms, systems and global financing.

The company offers the complete IoT solutions via its flagship "Watson IoT Platform". It gives customers the ability to completely manage their IoT landscape and make better, even real-time, business decisions. IBM Watson also offers cognitive capabilities to derive actionable insights from the IoT data. Some of the clients using Watson IoT include Kone, Whirlpool, SNCF.

IBM's Watson IoT platform offers the following key features:

Device Management: allows to perform device actions like rebooting or updating firmware, receive device diagnostics and metadata, or perform bulk device addition and removal.

Scalable Connectivity: using industry-standard MQTT protocol (OASIS ratified) to connect devices and applications. MQTT is designed for efficient exchange of data to and from devices in real-time.

Secure Communication: Securely receive data from and send commands to devices.

Data Lifecycle Management: provides access to historical as well as real-time data for devices.

The company reported decline in revenue growth for the second quarter of 2020. The revenue stood at $18.1 billion, down 5.4% YOY due to decline in Cognitive applications and Global business services segment, partially offset by strong Cloud performance. Given the uncertainty due to COVID-19 pandemic, the company did not provide any guidance for Q320 or for full year 2020.

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	June 30, 2019	**June 30, 2020**	**December 31, 2018**	**December 31, 2019**

[5] https://old.nasdaq.com/symbol/quik/stock-chart?&intraday=off&timeframe=1y&splits=off&movingaverage=None&lowerstudy=volume&comparison=on&index=sp500

Revenue	19,161	18,123	79, 591	77, 147
Operating Income	2,768	1,571	11,342	10,166
Net Income	2,498	1,361	8,728	9,431
Total Assets	154,652	154,200	123,382	152,186
Total Equity	17,776	20,688	16,929	20,985

Figure 6: LTM Performance vs. SPX 500 Index

Source: Nasdaq[6]

2.10 Kontakt.io

Kontakt.io provides secure and configurable beacon hardware and software for building proximity-aware IoT offerings. The company also supports Bluetooth Low Energy, iBeacon and other communications technologies. Apart from the above, the company also provides secure communication, secure shuffling, and software lock solutions to its customers. The company serves customers globally, especially in Europe, Canada, the United States and Japan.

It serves over 2,000 customers across diverse sizes and industries, ranging from transportation and logistics to manufacturing, healthcare, airports, governments and public spaces. These customers utilize company's solutions to reduce emergency incident time, decrease asset search-times, introduce activity-based-costing, automate manual processes, digitize physical order traceability or prevent machine downtimes.

Kontakt.io launched a COVID-19 contact tracer which leverages location data to monitor, detect, prevent, and control the virus spread by identifying likely infection chains early on, ensuring the health and emotional well-being of employees and visitors.

2.11 Oracle Corporation (Oracle) (NYSE: ORCL)

Oracle, an American computer technology company, primarily specializes in products and services that address all aspects of corporate information technology (IT) environments, application, platform and infrastructure. Oracle products and services can be found in organizations of all sizes, both public and private, across most industries and geographies.

The company provides IoT solution as a cloud offering. Oracle Internet of Things (IoT) Cloud Service is a secure and scalable platform to help organizations quickly build and deploy IoT applications and fully capture and analyze their IoT data.

---

[6] http://www.nasdaq.com/symbol/googl/stock-chart?andintraday=offandtimeframe=1yandsplits=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500

The company registered promising revenue growth for the first quarter on 2021 (ended 31 August 2020) beating its own guidance by $150 million. The revenue was $9.36 billion, up 2% YOY in constant currency. Cloud application business contributed to the growth.

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	August 31, 2020	August 31, 2019	May 31, 2020	May 31, 2019
Revenue	US$9,367	US$9,218	US$39,068	US$39,506
Operating Income	US$3,211	US$2,877	US$13,896	US$13,535
Net Income	US$2,137	US$2,137	US$10,135	US$11,083
Total Assets	US$113,546	US$106,229	US$115,438	US$108,709
Total Equity	US$10,140	US$19,019	US$12,717	US$22,363

Figure 7: LTM Performance vs. SPX 500

Source: Nasdaq[7]

2.12 Prodea Systems Inc

Founded in 2006, Prodea is a privately held company providing carrier-grade IoT services to government agencies, healthcare providers, telcos and utilities. Prodea offers white-label, value-added IoT services that can be easily integrated to client's offerings across smart home, smart city, security, digital health, energy, e-government, and other vertical markets.

The company's IoT solutions include the following:

Connected Product Services: aimed at brand manufacturers. This service gets a product connected through the Internet to enable other services like those listed below or to deliver valuable user experiences to field personnel and/or end users.

Health: offerings are dedicated chronic disease management, home wellness and elderly care. It includes aggregation of data from different health devices (glucometer, pulse oximeter, blood pressure monitor, thermometer, weight scale & activity tracker).

Smart Home: offerings include door, window, or motion sensors, door locks, sirens, indoor or outdoor cameras, lighting controls, which can be monitored or controlled from anywhere.

---

[7] https://old.nasdaq.com/symbol/ayx/stock-chart?&intraday=off&timeframe=1y&splits=off&movingaverage=None&lowerstudy=volume&comparison=on&index=sp500

2.13 PTC Inc (Nasdaq: PTC)

PTC Inc is a leading provider of IoT and Augmented Reality (AR) platform. Its flagship IoT offering includes ThingWorx platform.

ThingWorx is the market leader in enterprise IoT technology, enabling innovative companies to deliver smart connected products and solutions to customers globally. It enables customers to reduce the time, cost, and risk required to build and deploy IoT applications.

ThingWorx includes cloud-based tools that allow customers to easily and more securely connect products and devices to the cloud, and intelligently process and store product and sensor data. ThingWorx also offers sophisticated artificial intelligence and machine learning technology that enables customers to simplify and automate complex analytical processes that enhance industrial IoT solutions through real-time insights, predictions and recommendations.

PTC has entered into three strategic partnerships – Rockwell Automation, Microsoft and ANSYS to augment the capabilities of its core solutions, and IoT offerings and expand its addressable markets.

PTC reported strong revenue growth for Q320 (three months ended 28 March 2020). The company delivered revenue of $352 million, up 19% YOY. For the fiscal 2020, the company expects solid revenue generation and expects revenue to be in the range of $1,415 - $1,430 million (earlier $1,400 - $1,430 million).

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	June 29, 2019	June 27, 2020	September 30, 2018	September 30, 2019
Revenue	US$295	US$351	US$1,241	US$1,255
Operating Income	US$9	US$63	US$78.9	US$117
Net Income	-US$14	US$34	US$52	-US$27.5
Total Assets	US$2,448	US$3,376	US$2,329	US$2,666
Total Equity	US$906	US$1,327	US$874	US$1,202

Figure 8: LTM Performance vs. SPX 500 Index
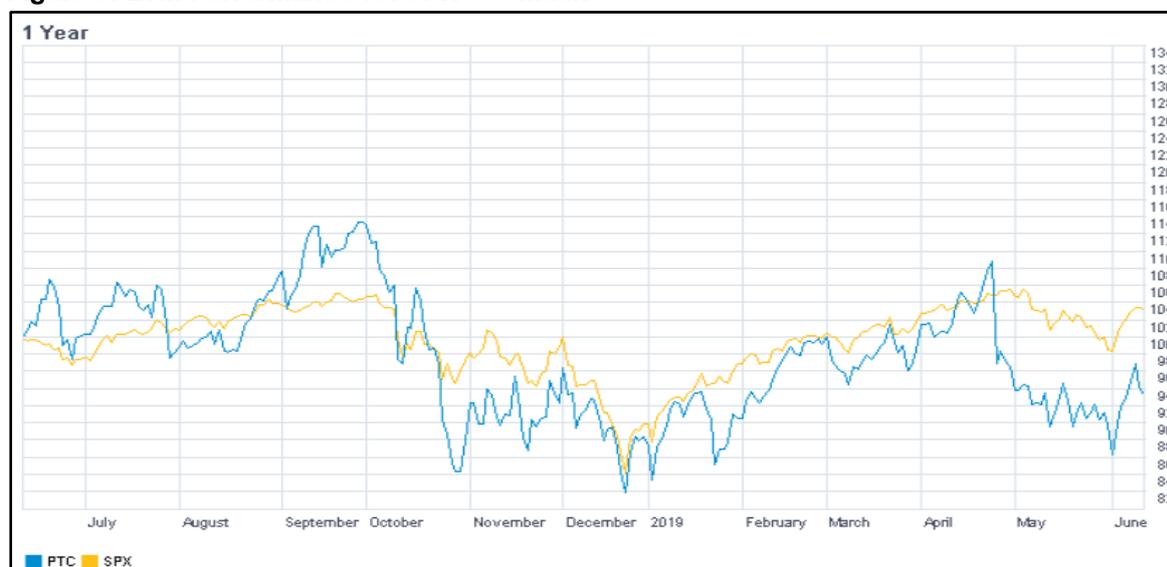
Source: Nasdaq[8]

2.14 Qualcomm Inc (NASDAQ: QCOM)

Qualcomm is engaged in the development and commercialization of semiconductor and telecommunications products and services. The company operates through three segments — Qualcomm CDMA Technologies (QCT), Qualcomm Technology Licensing (QTL) and Qualcomm

---

[8] http://www.nasdaq.com/symbol/intc/stock-chart?andintraday=offandtimeframe=1yandsplits=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500

Strategic Initiatives (QSI). Qualcomm is hitting the lucrative market by forming partnerships with strategic companies, plus introducing its own IoT technologies and services to the market. In fact, Qualcomm now holds the highest number of essential patents in the IoT technologies, which suggests it could be a bigger player in the IoT market in the future.

Its key IoT solutions include: Qualcomm Snapdragon Processors and LTE modems. Qualcomm Snapdragon platforms are designed to support computing and processing capabilities for edge IoT devices. The company's IoT solutions are used in serving consumer verticals including wearables, cameras and appliances.

According to data from the GSMA, the world will see 3.2 billion cellular IoT connections in 2024. In April 2020, Qualcomm launched a breakthrough new product to drive the growth of cellular IoT: the Qualcomm 212 LTE IoT Modem, the world's most power-efficient single-mode NB2 (NB-IoT) chipset.
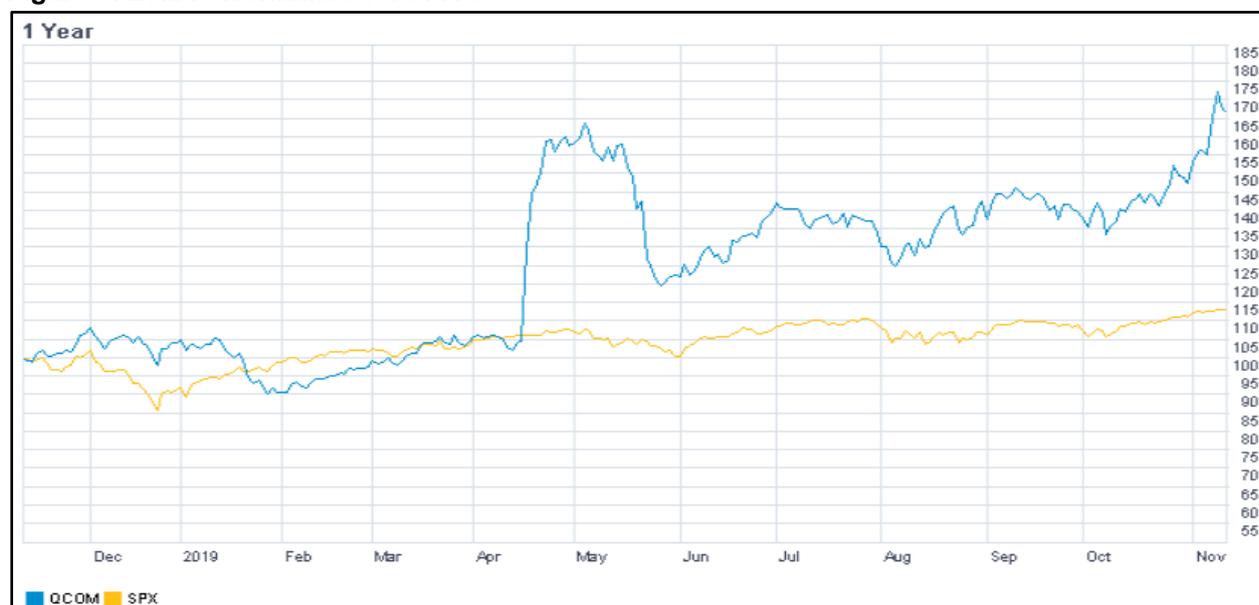
The company delivered flat revenue growth for Q320 (three months ended 28 June 2020). Qualcomm reported revenue of $4.89 billion, flat YOY. The company expects Q420 revenues to be in range of $5.5 - $6.3 billion.

In June 2020, the company launched a new IoT-enabled building access product which uses body temperature and facial recognition to provide access to the right people. This is useful for schools and businesses which are looking to reopen safely amid the COVID-19 pandemic.

Latest Key Financial Data

(In millions of US$)	Quarter Ending		Fiscal Year Ending	
	June 30, 2019	**June 28, 2020**	**September 30, 2018**	**September 30, 2019**
Revenue	US$4,894	US$4,890	US$22,611	US$24,273
Operating Income	US$1,101	US$1,104	US$621	US$7,667
Net Income	US$982	US$982	US$(4,964)	US$4,386
Total Assets	US$34,133	US$32,328	US$32,718	US$32,957
Total Equity	US$5,463	US$3,306	US$807	US$4,909

Figure 9: LTM Performance vs. SPX 500

Source: Nasdaq[9]

---

[9] http://www.nasdaq.com/symbol/fb/stock-chart?andintraday=offandtimeframe=1yandsplits=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500

2.15 Salesforce.com Inc (NYSE: CRM)

Salesforce.com is an American cloud computing company whose revenues mostly derive from customer relationship management (CRM) products. The company also capitalizes on commercial applications of social networking through acquisition.

The salesforce IoT cloud allows customers to turn data generated by IoT devices into meaningful actions. The cloud solution connects data from every device, sensor, website, and interaction with salesforce to get a more complete view of the customers.

The company also boasts of an IoT platform, myIoT, which is intended to make it easier for inexperienced businesses to utilise the technology. myIoT has an easy-to-use point-and-click interface that helps developers connect, configure and leverage IoT devices. Besides this, it offers some additional IoT solutions for businesses. This includes Salesforce IoT Insights for Field Service Lightning product which provides businesses to gain a better understanding of the IoT devices operating with their systems and will enable them to isolate issues and deploy the right person to fix them.

The company reported strong revenue growth for the second quarter of fiscal 2021 (ended 31 July 2020). Its revenue was $5.15 billion, up 29% YOY. The success in the quarter was majorly contributed by Customer 360 platform. Revenue in all the segments grew for the quarter. The company initiated Q321 revenue guidance to be in the range of $5.24-$5.25 billion, indicating 16% YOY growth. The company increased its fiscal 2021 revenue guidance to $20.7 - $20.8 billion (earlier ~$20 billion).

Latest Key Financial Data

(In Millions of US$)	Quarter Ending		Fiscal Year Ending	
	July 31, 2019	July 31, 2020	January 31, 2019	January 31, 2020
Revenue	US$3,997	US$5,151	US$13,282	US$17,098
Operating Income	US$58	US$178	US$535	US$297
Net Income	US$91	US$2,625	US$1,110	US$126
Total Assets	US$33,336	US$57,780	US$30,737	US$55,126
Total Equity	US$17,166	US$38,440	US$15,605	US$33,885

Figure 10: LTM Performance vs. S&P 500 Index

Source: Nasdaq[10]

2.16 Samsung Electronics Company Ltd (KRX: 005930)

Samsung Electronics mainly engages in the production of consumer electronic products. The corporation comprises numerous subsidiaries and affiliated businesses, most of them running under the Samsung brand; it is also the largest South Korean business conglomerate.

Like Apple, Samsung is also tapping into IoT market and has made a number of investments in IoT-related startups in the US. The company stated that it plans to make all its products IoT ready by 2020. Samsung ranks among the largest non-U.S. spender on research and development.

The company's key IoT solutions include LoRaWAN technology, NB-IoT technology and IoT Gateway. Other IoT offerings include smart home speaker, Galaxy Home, which is powered by Bixby assistant as well as IoT solutions for connected vehicles.

Samsung reported weak revenue generation for Q220 (three months ended 30 June 2020). The company revenue was KRW 52.9 trillion, down 6% YOY due to decline across segments.

In October 2019, Samsung announced that its IoT platform SmartThings has over 45 million monthly active users and works with more than 5,000 devices from 100 different manufacturers. For instance, Vodaphone adopted SmartThings for its V-Home system, which uses it to manage security devices from smoke detectors to alarms, and Korea Power Exchange tapped SmartThings to help its customers manage their home energy use.

Latest Key Financial Data

(In Trillions of KRW)	Quarter Ending		Fiscal Year Ending	
	June 30, 2019	June 30, 2020	December 31, 2018	December 31, 2019
Revenue	KRW56.1	KRW52.9	KRW243.77	KRW230.40
Operating Income	KRW6.6	KRW8.1	KRW58.89	KRW27.77
Net Income	KRW5.1	KRW5.5	KRW44.34	KRW21.74
Total Assets	KRW342.9	KRW357.9	KRW339.3	KRW352.5
Total Equity	KRW257.7	KRW269.8	KRW247.7	KRW262.8

Figure 11: LTM Performance vs. KOSPI Composite Index
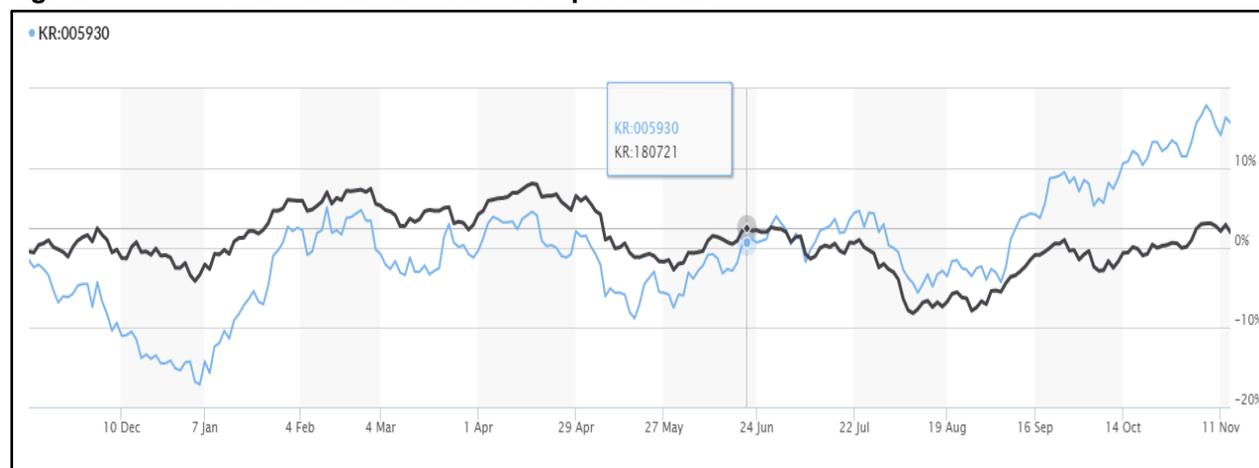
Source: Marketwatch[11]

2.17 Seebo Interactive

Seebo provides technology solutions to create, develop, analyse, and maintain smart and IoT enabled toys. Its technology includes software development tools, and runtime software and cloud solutions. The company also helps its customers with concept and creative support, rapid prototyping service, app developer matching, electronic sourcing support, support for production setup and post-launch support.

Seebo customers include leading manufacturers across multiple industries, like Barilla, Nestle, Mondelez, PepsiCo, Allnex and Volkswagen Group. Seebo is backed by Viola Ventures, Ofek Ventures, Vertex Ventures and TPY Capital. Seebo has raised total fund of $22 million so far.

Seebo's solutions are being used in the manufacturing industry. Seebo captures data from the production line and delivers actionable insights to manufacturing teams so that losses can be identified and anticipated. Nestle, the world's largest food and beverage manufacturer implemented Seebo's solution at its factories to solve their yield, waste and quality challenges.

2.18 Silicon Laboratories Inc (Nasdaq: SLAB)

Silicon Laboratories Inc designs, develops, and markets integrated circuits (ICs) in the United States, China, and internationally. The company offers Internet of things products, such as 8-bit mixed-signal, 32-bit wireless, and ultra- low-power 32-bit microcontrollers; and wireless connectivity devices comprising a range of integrated and low power transceivers, as well as sensor products, including optical and relative humidity/temperature sensors.

Its key IoT products include:

Microcontrollers and Wireless Products: It offers a family of products ideally suited to ultra-low power IoT embedded systems that include energy friendly mixed-signal microcontrollers, ultra-low power 32-bit microcontroller and wireless connectivity solutions. Its broad portfolio addresses a variety of target markets, including smart home, commercial (building automation and retail) and industrial (smart energy, factory automation, smart cities).

Sensors: IoT sensor products include optical sensors (proximity, ambient light gestures and heart rate monitoring), as well as relative humidity (RH) / temperature sensors and Hall effect magnetic sensors.

The company reported weak revenue generation for Q220. The company revenue was $207.5 million, down 3.4% YOY due to drop in IoT revenue ($115.1 million). For Q320, the company expects revenue to be in the range of $208-$218 million.

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	July 29, 2019	July 4, 2020	December 29, 2018	December 28, 2018
Revenue	US$206	US$207	US$868	US$837
Operating Income	US$14.5	US$7.0	US$85.2	US$56.6
Net Income	-US$16	-US$1.8	US$83.5	US$19.2
Total Assets	US$1,602	US$1,923	US$1,624	US$1,674
Total Equity	US$1,051	US$1,157	US$1,067	US$1,115

Figure 12: LTM Performance vs. SPX 500

Source: Nasdaq[12]

2.19 VMware Incorporated (NYSE: VMW)

VMware, founded in 1998, is a virtualization infrastructure solutions and cloud infrastructure solutions provider. In 2004, the company was purchased by and became a subsidiary of EMC Corporation (NYSE: EMC). Later on 14 August 2007, EMC sold 15% of the company in a New York Stock Exchange IPO and from then VMware was traded under VMW in the exchange.

VMware develops and sells its product and service offerings within three product groups — software-defined data center (SDDC), hybrid cloud computing and end-user computing (EUC). The company's computer virtualization includes offerings that allow organizations to manage information technology resources across private clouds and complex multi-cloud, and multi-device environments.

VMware delivers IoT coverage with its Workspace ONE and VMware Pulse IoT Center solutions. In March 2020, VMware announced the end of its Pulse IoT Center product line. Pulse IoT Center was a secure, enterprise grade, end-to-end IoT infrastructure management solution which allows companies to completely control and manage their IoT assets. The company noted that it is now focusing on edge IoT and will introduce new product offerings to serve the same.

The company has extended its IoT offering with new edge computing solutions for specific use cases including asset management and surveillance. The products will initially be targeted at three verticals: remote locations such as oil rigs, factories and retail branches.

VMware reported robust results for the second quarter of FY21 (three months ended on 31 July 2020). The company reported revenue of $2.87 billion, up 9% YOY. The revenue growth was driven by Subscription and Saas segment and Services segment, while License revenue dropped.

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	July 31, 2020	**August 2, 2019**	**January 31, 2020**	**February 1, 2019**
Revenue	US$2,875	US$2,632	US$10,811	US$9,613
Operating Income	US$534	US$466	US$1,441	US$1,803
Net Income	US$447	US$5,285	US$6,356	US$1,590
Total Assets	US$28,175	US$20,372	US$26,294	US$17,593
Total Equity	US$7,907	US$5,199	US$7,009	US$2,891

Figure 13: LTM Performance vs. SPX 500 Index

---

[12] https://old.nasdaq.com/symbol/nvda/stock-chart?&intraday=off&timeframe=1y&splits=off&movingaverage=None&lowerstudy=volume&comparison=on&index=sp500

Source: Nasdaq[13]

2.20 Zebra Technologies Corp (Nasdaq: ZBRA)

Zebra Technologies Corporation is a global leader in solutions and services that provide real-time visibility into organisations' assets, people and transactions. Zebra Technologies also provides IoT Solutions through its platform, Zatar, which is a Chip-to-Cloud standard based IoT service. Zebra Technologies has been recognized on the 2019 Internet of Things 50 list from CRN.

The company merged Zatar with its new big data and analytics engine to create more robust IoT Data Platform. Some of its other IoT-focused solutions include: 1) Savanna, a centralized data platform designed to empower enterprise applications; 2) SmartLens for Retail, dedicated to retail sector and 3) SmartPack Trailer, dedicated to transportation & logistics sector.
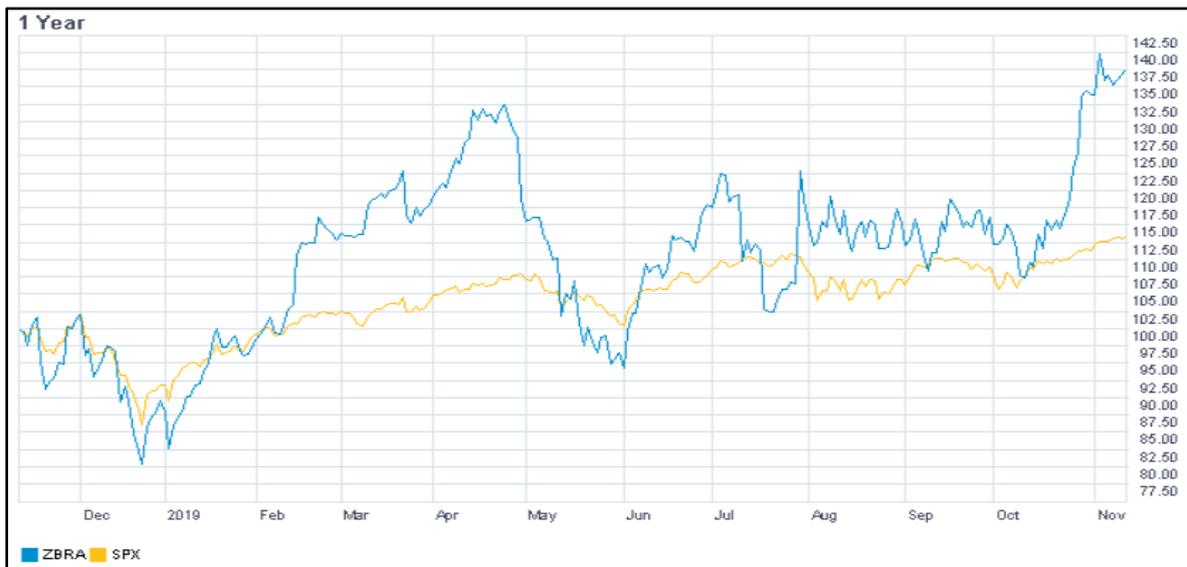
Zebra had a disappointing second quarter 2020, impacted by COVID-19. The company reported weak revenue growth. Zebra reported revenue of $956 million, down 12.9% YOY. The company expects Q320 net sales to decrease approximately 3% to 7% YOY. The company expects adjusted EBITDA margin, and free cash flow for fiscal 2020 to be lower than last year but hope to see some improvement in sales in second half of this fiscal year.

Latest Key Financial Data

(In millions of US$)	Three Month Ending		Fiscal Year Ending	
	September 29, 2018	July 27, 2020	December 31, 2018	December 31, 2019
Revenue	US$1,097	US$956	US$4,218	US$4,485
Operating Income	US$160	US$119	US$610	US$692
Net Income	US$124	US$100	US$421	US$544
Total Assets	US$4,701	US$4,607	US$4,339	US$4,711
Total Equity	US$1,559	US$1,803	US$1,335	US$1,839

Figure 14: LTM Performance vs. SPX 500 Index

[13] http://www.nasdaq.com/symbol/amzn/stock-chart?andintraday=offandtimeframe=1yandsplits=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500

Source: Nasdaq[14]

[14] http://www.nasdaq.com/symbol/intc/stock-chart?andintraday=offandtimeframe=1yandsplits=offandmovingaverage=Noneandlowerstudy=volumeandcomparison=onandindex=sp500

Key References

International Telecommunication Union (ITU)

The International Telecommunication Union is an agency of the United Nations (UN) that is responsible for issues that concern information and communication technologies.

https://www.itu.int/

Internet of Things Consortium

The Internet of Things Consortium is a non-profit member-based organization that connects a global community of leading companies building IoT.

http://www.iofthings.org

Organisation for Economic Cooperation and Development (OECD)

An international organization that helps governments tackle the economic, social and governance challenges of a globalized economy.

http://www.oecd.org

Institute of Electrical and Electronics Engineers (IEEE)

The Institute of Electrical and Electronics Engineers is the world's largest association of technical professionals. Its objectives are the educational and technical advancement of electrical and electronic engineering, telecommunications, computer engineering and allied disciplines.

https://www.ieee.org/

Information Technology Association of America (ITAA)

A trade association that represents the broad spectrum of the US IT industry; the ITAA also provides information about the IT industry.

http://www.itaa.org

US Department of Commerce (DoC)

The department coordinates US government commerce policy. Encompassing a number of key government agencies, it also provides business products, services, information and resources.
http://www.commerce.gov

Semiconductor Equipment and Materials International (SEMI)

Semiconductor Equipment and Materials International is an international trade association representing companies that develop, manufacture and supply the technology, equipment, materials and services used to manufacture semiconductors, photovoltaic, and flat panel displays.

http://www.semi.org/

Semiconductor Industry Association (SIA)

The SIA represents the US semiconductor industry. It also conducts research and publishes statistics and forecasts.

http://www.sia-online.org

Internet Industry Association (IIA)

The IIA represents Australian internet industry companies, primarily internet service providers.
http://www.iia.net.au

Infocomm Development Authority of Singapore (IDA)

The IDA regulates information and telecommunications activities in Singapore.

http://www.ida.gov.sg

Statistics Canada

Canada's national statistical agency deals with social and economic statistics and products.
http://www.statcan.ca